Effect of *Bradyrhizobia* inoculant formulation and phorate insecticide on peanut cultivars when applied in-furrow during planting

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Introduction and Objectives

Bradyrhizobia Inoculants have a proven record of improving peanut production; especially in fields where peanut is not part of a regular rotation. Another in-furrow product in peanut production is the granular insecticide phorate which primarily controls thrips (*Frankliniella fusca* and *Frankliniella occidentalis* are the most prevalent species in peanut). Yet, since phorate is an organophosphate compound, it is highly toxic to many living organisms in addition to thrips. Because the *Bradyrhizobia* needed for N-fixation to occur are living organisms, there are concerns regarding the placement together and residence of phorate and *Bradyrhizobia* in the same furrow, for fear of an antagonistic effect reducing the efficacy of the inoculant. Therefore, the objective of this research was to assess response of peanut to liquid and sterile peat inoculants in the presence or absence of phorate in fields with no history of growing peanut.

Materials and Methods

Location: Tifton, GA
Planting Dates: 28 May 2013 and 3 June 2014
Digging Dates: 28 October 2013 and 29 October 2014; based on Hull-Scrape Maturity Profile.
Harvest Dates: 5 November 2013 and 4 November 2014
Replications: 4
Experimental Design: Randomized Complete Block, factorial arrangement of 3 treatment variables:
Cultivar = (1) Georgia-06G, (2) Georgia-12Y
Inoculant = (1) non-treated, (2) sterile peat, (3) liquid
Insecticide = (1) non-treated, (2) phorate in-furrow
Crop Management: followed UGA Extension recommendations for peanut. Plots were not irrigated
Data Collection: yield; grade; nodule quantity, mass and activity; days to vegetation overlap; SPAD; canopy reflectance (NDVI)
Data Analyses: PROC GLIMMIX, SAS 9.2

Results

Table 1. Effect of inoculant formulation on nodule characteristics and total sound mature kernels (TSMK). Nodule rating and TSMK averaged over 2013-2014; nodule mass and nodule activity for 2013 data only.

Inoculant	Nodule rating (1-5 scale)[a]	Nodule mass (g plant^{-1})	Active nodules (%)	TSMK (%)
Non-treated	4.5 B[b]	0.39 C	68 B	70.4 B
Sterile peat	4.6 B	0.92 B	91 A	70.6 B
Liquid	4.9 A	1.20 A	88 A	71.8 A
SE[c]	± 0.1	± 0.12	± 6	± 0.6

[a] Rating scale represents average number of nodules per root with 0=no nodules, 1=1-5, 2=6-10, 3=11-15, 4=16-20, and 5=>20 nodules per root.
[b] Means within a column followed by the same letter are not significantly different at P=0.05.
[c] Standard error of the mean.

Table 2. Interaction of inoculant formulation with phorate for days to vegetation overlap averaged over 2013-2014, and interaction of inoculant formulation with cultivar for yield in 2013.

Inoculant	days to vegetation overlap		Pod yield (kg ha^{-1})	
	Phorate	No phorate	Georgia-06G	Georgia-12Y
Non-treated	73 A[a]	75 A	4060 B	4600 A
Sterile peat	75 A	66 B	4860 A	5020 A
Liquid	64 B	63 B	5350 A	4670 A
SE[b]	± 3		± 290	

[a] Means within a column followed by the same letter are not significantly different at P=0.05.
[b] Standard error of the mean.

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Results (Cont.)

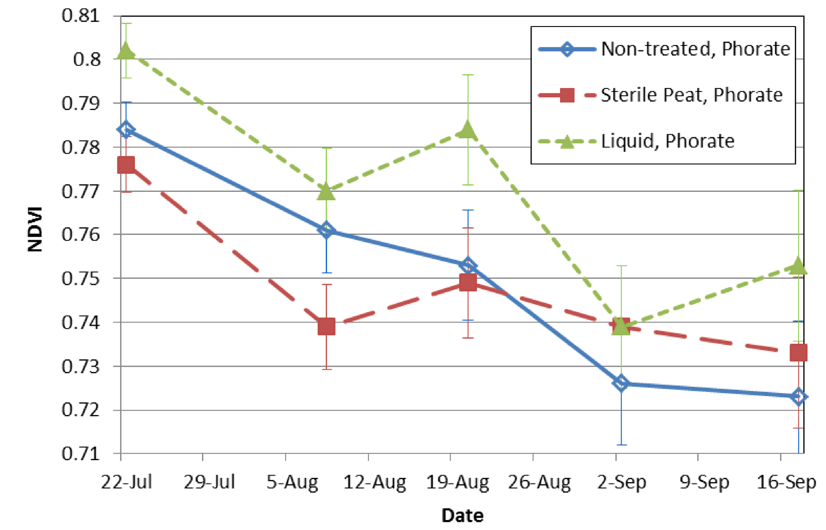

Fig. 1. Canopy light wavelength reflectance as normalized difference vegetation index (NDVI) for inoculant treatments including phorate in-furrow, averaged over cultivars, Tifton, GA, 2014.

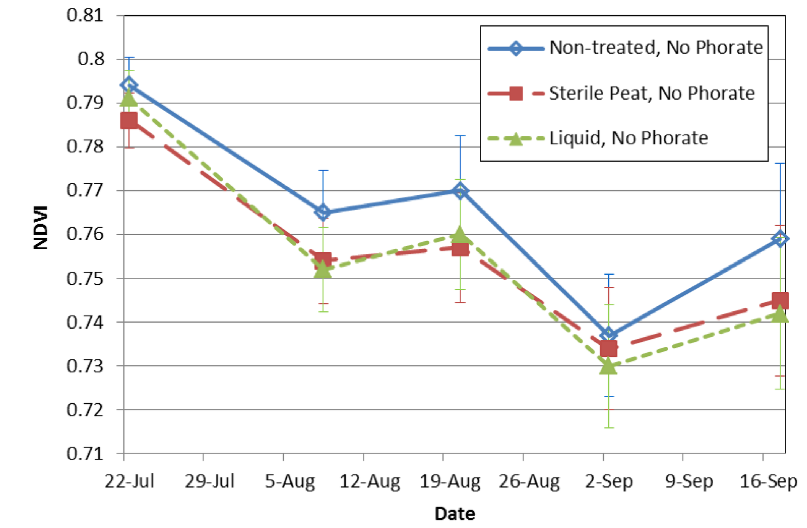

Fig. 2. Canopy light wavelength reflectance as normalized difference vegetation index (NDVI) for inoculant treatments without phorate, averaged over cultivars, Tifton, GA, 2014.

Discussion and Conclusions

Because there were no interactions between inoculant and phorate treatments for yield or grade, this is an indication that phorate does not reduce the efficacy of *Bradyrhizobia* peanut inoculants. The liquid inoculant was superior to both the sterile peat formulation and the non-treated for nodule rating (Table 1), meaning there were more nodules per plant on average using the liquid formulation. The total nodule mass is improved using the liquid formulation compared to the sterile peat and non-treated plants, although the sterile peat treatment does still improve nodulation over the non-treated (Table 1). Both of the inoculant formulations improve the viability of nodule activity compared to the local strains of bacteria already residing in the soil by 20% or more (Table 1). There was more than a 1% improvement in grade when using the liquid inoculant compared to the sterile peat or non-inoculated treatments (Table 1). The liquid inoculant provided quicker vegetative coverage regardless of the use of phorate (Table 2). While positive crop responses were observed, only the liquid inoculant with Georgia-06G peanut resulted in a yield improvement (32% increase) over the non-treated peanuts in 2013 (Table 2).

The inclusion of phorate with an inoculant did not negatively impact NDVI values compared to the non-treated with phorate (Fig. 1), and increased NDVI with the liquid formulation on several dates. Considering there were no differences in NDVI among treatments when phorate was not included in the furrow (Fig. 2), and the SPAD data (not shown) displayed no differences in chlorophyll content likely ruling out a difference in foliage hue, the improvement in NDVI when the liquid inoculant and phorate were both used suggests there was a higher percentage of vegetation covering the soil surface where both the liquid inoculant and phorate were used.

In-season plant health status and growth were not negatively impacted, nor were yield and grade, so growers can proceed with using the combination of materials they prefer without fear of harm to peanut. Although yield and grade are not always improved with liquid inoculant compared to the sterile peat formulation, it is consistently equal and yield can be up to 25% greater (Lanier *et al.*, 2005), and grade was more than a 1% improvement in this experiment.

Lanier, J.E., D.L. Jordan, J.F. Spears, R. Wells, and P.D. Johnson. 2005. Peanut response to inoculation and nitrogen fertilizer. Agron. J. 97:79-84.